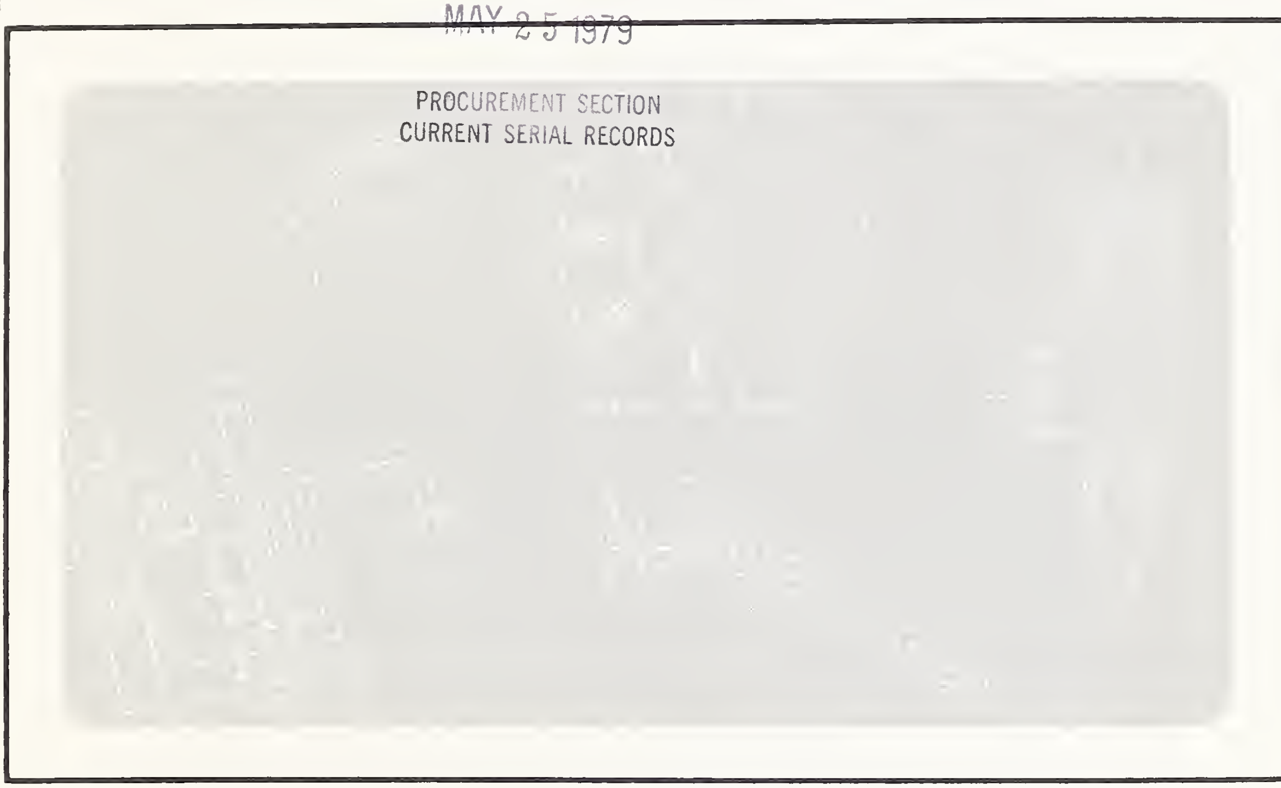
Equipment for Cooling Larval Diet in a Boll Weevil Mass-Rearing Operation



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Stanley Malone, research technician, Robert T. Gast Rearing Laboratory, Animal and Plant Health Inspection Service, and W. C. Jordan, H. K. Harsh, and H. A. Stephens, engineering technicians, Boll Weevil Research Laboratory, Science and Education Administration, assisted in the development of this equipment.

This publication is available from the Boll Weevil Research Laboratory, P.O. Box 5367, Mississippi State, Miss. 39762.

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ILLUSTRATIONS

Equipment for Cooling Larval Diet in a Boll Weevil Mass-Rearing Operation

By J. G. Griffin[1]

ABSTRACT

In the mechanized in-line operation used to plant boll weevil eggs, sterile larval diet must be cooled after being dispensed into rearing trays so that it is solid enough to support the eggs that are placed on the diet surface. The cooling system consists of a refrigerated tunnel through which the trays of warm diet pass and into which cold, filtered air is blown. The equipment is capable of cooling the trays of diet at the capacity of the production line (14 trays per minute) and helps to prevent microbial contamination of the diet. Index terms: *Anthonomus grandis* Boheman, insect-diet handling, insect-rearing equipment.

INTRODUCTION

Equipment was developed earlier to help mechanize egg planting in a boll weevil (*Anthonomus grandis* Boheman) mass-rearing operation (Griffin 1978). With this equipment, sterile larval diet at approximately 40° C was dispensed by a filler machine to a depth of approximately 9 millimeters in the cavities of trays formed by a form-fill-seal machine. The diet at this temperature was the consistency of a medium-thick slurry and had to be cooled and jelled in the trays to make it firm enough to support the weevil eggs when they were planted on the surface of the diet. Cooling slowed down the operation, and the cooling air caused microbial contamination of the diet. An improved system for cooling the diet and for filtering the cooling air is described here. It is used in-line with the form-fill-seal machine at the Robert T. Gast Rearing Laboratory.

EQUIPMENT

The cooling system is composed of two separate units joined by a flexible duct (figs. 1 and 2). One unit contains an air prefilter, a blower, two direct-expansion refrigeration coils, and a high-efficiency particulate air (HEPA) filter. These are installed in tandem in a section of insulated duct. The second unit consists of an insulated, refrigerated tunnel with a hinged lid and a perforated-metal diffusion trough that fits inside the tunnel. The hinged lid allows the tunnel to be opened for cleaning and sanitizing to control microbial contamination. Both the duct section and the tunnel are insulated with 1½ inches of foam insulation. The blower, a squirrel-cage type, is rated at 385 cubic feet per minute at 0.5 inch of water static pressure.

The two cooling coils are from a standard window air conditioner rated at 10,000 Btu. The refrigerant passes through only one coil at a time to allow continuous operation at coil temperatures of −5° to −10° C without freezeup. A 10-minute cycle timer and a solenoid valve control and direct the flow of the refrigerant from the compressor through the coils. The coils operate alternately for 5 minutes. With this timing, they do not frost up enough during the "on" cycle to restrict airflow, and they defrost during the "off" cycle. A drip pan under the cooling coils catches the condensate.

The HEPA filter is 24 by 24 by 5⅞ inches and is rated for 700 cubic feet per minute at 0.5 inch of water pressure drop and a 95-percent DOP (dioctyl phtholate) efficiency (removes 95 percent of all particles 0.3 micrometer in diameter). The filter cleans

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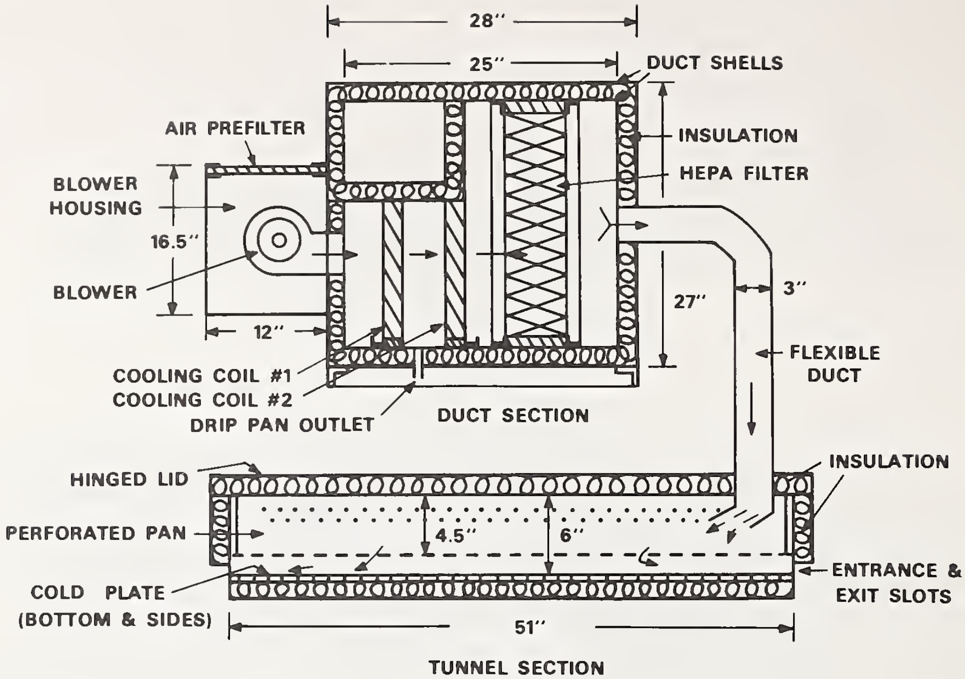

FIGURE 1.—Cross section of cooling system.

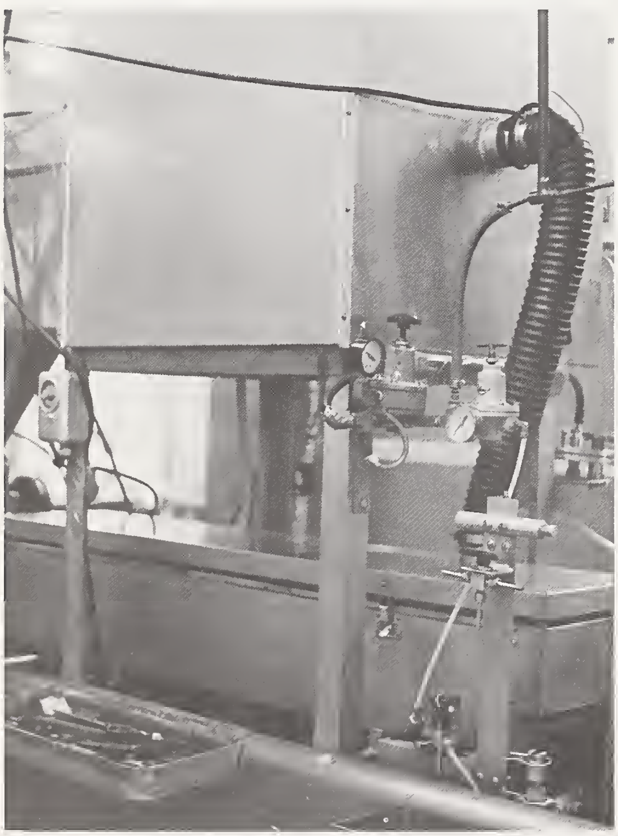

FIGURE 2.—Cooling system installed.

the circulating air of bacteria and fungi before it enters the tunnel and comes in contact with the sterile larval diet.

The interior walls and bottom of the tunnel are constructed of specially fabricated, direct-expansion refrigeration cold plate. The unit, fabricated by the Paul Mueller Co., Springfield, Mo., is 51 inches long, 8 inches wide, and 6 inches deep (inside dimensions). This length is all the space available for the unit along the production line of the presently used form-fill-seal machine. The tunnel is enclosed except for the 1½- by 8-inch entrance and exit slots in the ends for the ribbon of trays to pass through.

The diffusion trough (pan) is perforated with quarter-inch holes spaced on 1-inch centers over the bottom surface except for a 5-inch strip at each end. There are two rows of holes near the top of the sidewalls; these holes allow the entering air to be diffused over the sidewalls and bottom of the tunnel, thereby losing more of its heat to these cold surfaces. The trough is 51 inches long, 6 inches wide, and 4½ inches deep, and there is a 1-inch-sidewall and 1½-inch-bottom clearance between it and the tunnel. Two baffle plates located in the trough equalize the airflow through the perforated surfaces.

A 3-inch-diameter inlet pipe is installed in the lid

of the tunnel for connecting the flexible hose between the two units of the cooling system. An adjustable deflector on the interior end of the pipe directs the air along the trough.

Although one refrigeration compressor can serve the coils and cold plate, two small-capacity ones are used so that the entire operation will not be stopped by compressor malfunction. One compressor serves the coils and the other serves the cold plate, but either alone is adequate to keep the machine operating at about one-half capacity. The compressors are classed as medium-temperature units and are rated for 7,400 Btu at −4° C evaporation temperature.

OPERATION

The blower pulls room air through the prefilter and forces it through the cooling coils, HEPA filter, and flexible hose joining the two units; into and through the diffusion trough; and around and onto the trays of diet as they are moved through the bottom of the tunnel by the conveyor system of the form-fill-seal machine. The air leaves the cooling coils at approximately 0° C. The air temperature in the bottom of the tunnel is maintained at about −8° to −10° C without the trays of warm diet entering, but this temperature increases to 0° to 2° C during the normal planting operation.

The cooling furnished by the system allows production of approximately 14 trays per minute, which is the full capacity of the form-fill-seal machine. This system gave satisfactory performance during an 8-week mass-rearing test during the summer of 1977, when approximately 2,550 trays per day were planted to produce approximately 800,000 weevils per day. It has given satisfactory performance in regular daily operation since that time. The problem of microbial contamination of the larval diet has been practically eliminated. With the above production rate, the new cooling system has saved approximately 4½ hours of operating time and 9 man-hours of labor each day. It has also allowed for a larger production during a regular workday.

REFERENCE

Griffin, Jack G.
1978. System for planting weevil eggs in a mass rearing operation. Trans. ASAE 21(3): 469–472.

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